

호흡 생리의 이해

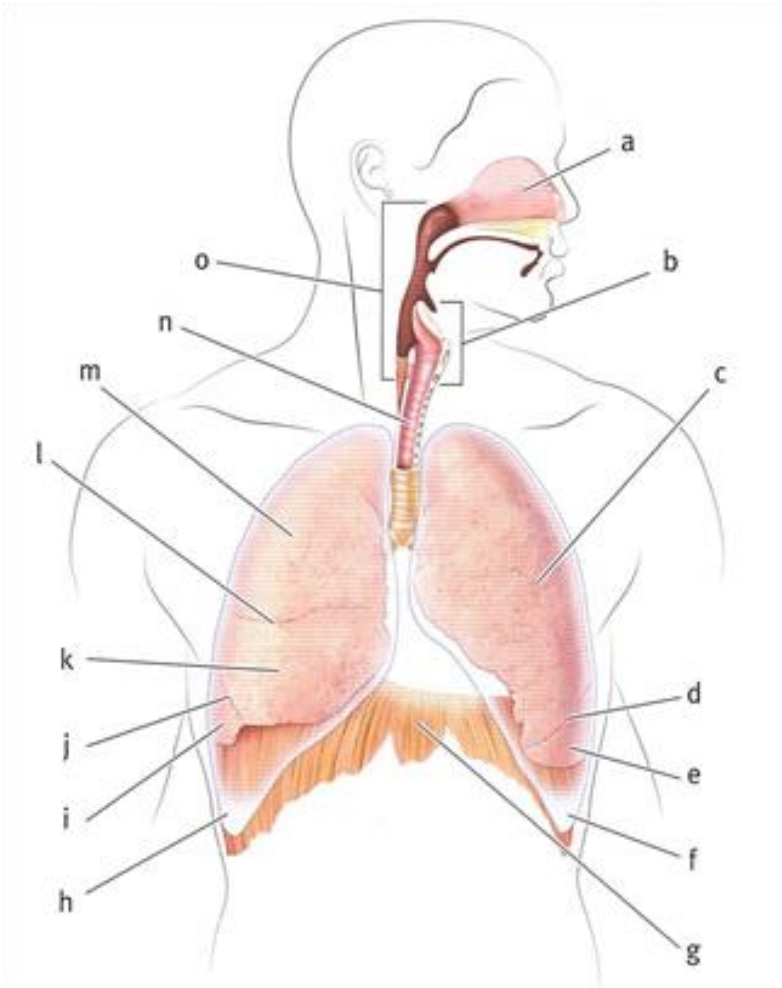
건국대학교 병원 호흡기알레르기 내과

김유림

INDEX

- 호흡 기계의 구조
- 호흡의 과정
 - 폐포환기 (ventilation)
 - 외호흡
 - 혈액을 통한 O₂, CO₂ 운반
 - 내호흡
- Summary

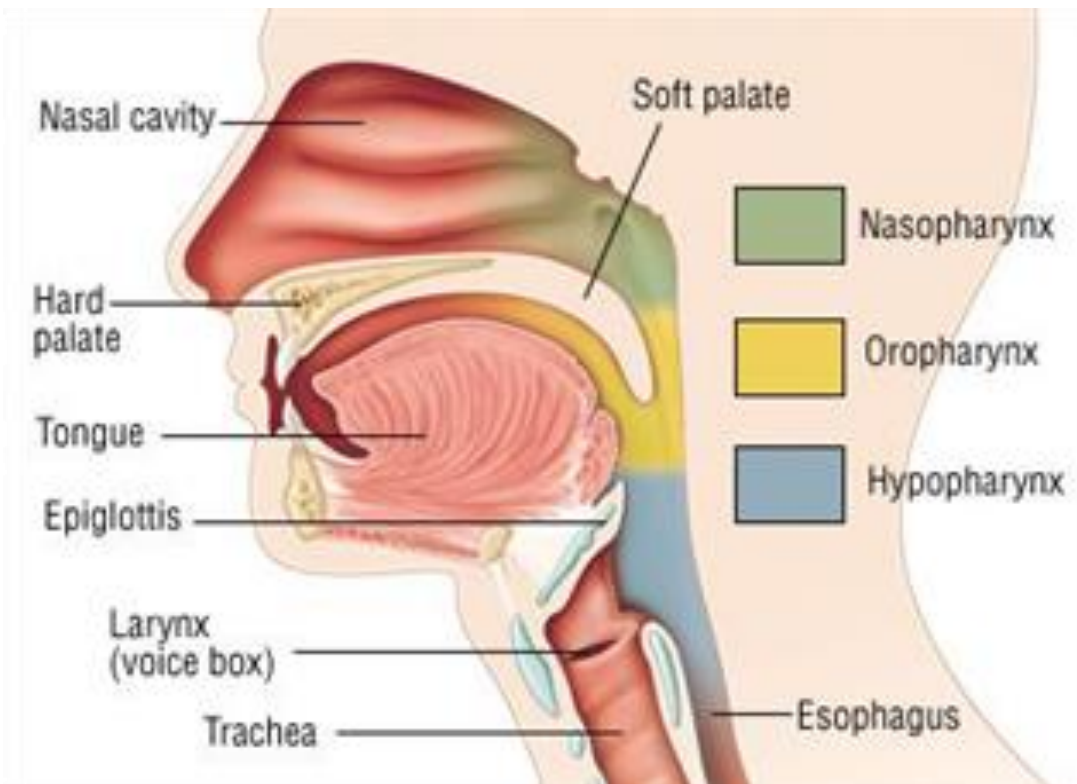
호흡기계



- a. Nasal cavity
- b. Larynx
- c. Upper lobe, left lung
- d. Oblique fissure, left lung
- e. Lower lobe, left lung
- f. Left pleura
- g. Diaphragm
- h. Right pleura
- i. Lower lobe, right lung
- j. Oblique fissure, right lung
- k. Middle lobe, right lung
- l. Horizontal fissure
- m. Upper lobe, right lung
- n. Trachea
- o. Pharynx

호흡 기계의 구조

상부 호흡기

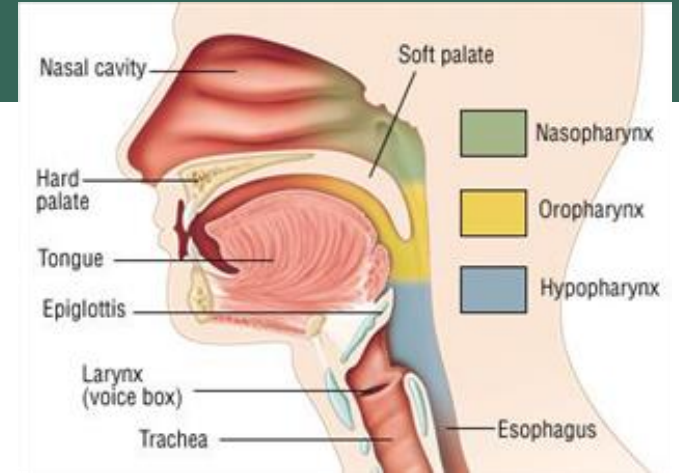


하부 호흡기

Conducting airways				Respiratory unit	
Trachea	Bronchi, segmental bronchi	Sub-segmental bronchi	Bronchioles		Alveolar ducts, alveoli
			Non-respiratory	Respiratory	
Generations	8	15	21-22	24	28

전도 영역

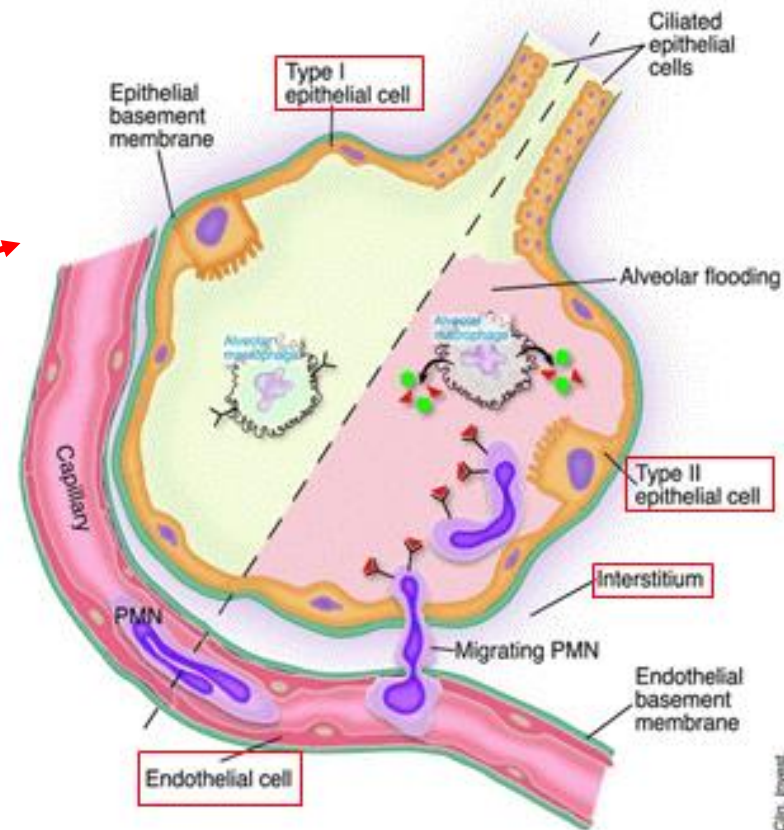
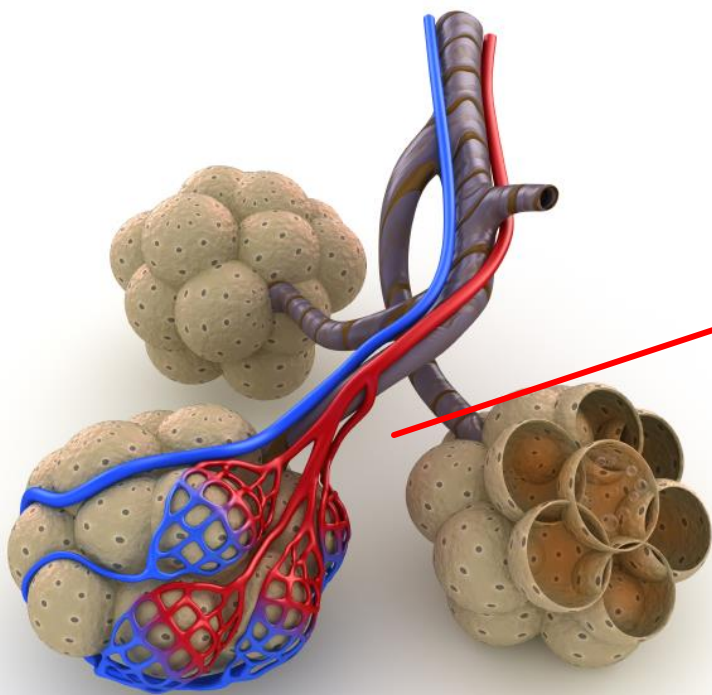
- 가스 교환이 없는 구간
- 공기의 이동 통로
- 청소 (cleaning), 가온 (warming), 가습 (moistening)



Conducting airways				Respiratory unit	
Trachea	Bronchi, segmental bronchi	Sub-segmental bronchi	Non-respiratory Bronchioles	Respiratory Bronchioles	Alveolar ducts, alveoli
Generations	8	15	21-22	24	28

호흡 영역

- 가스 교환에 참여



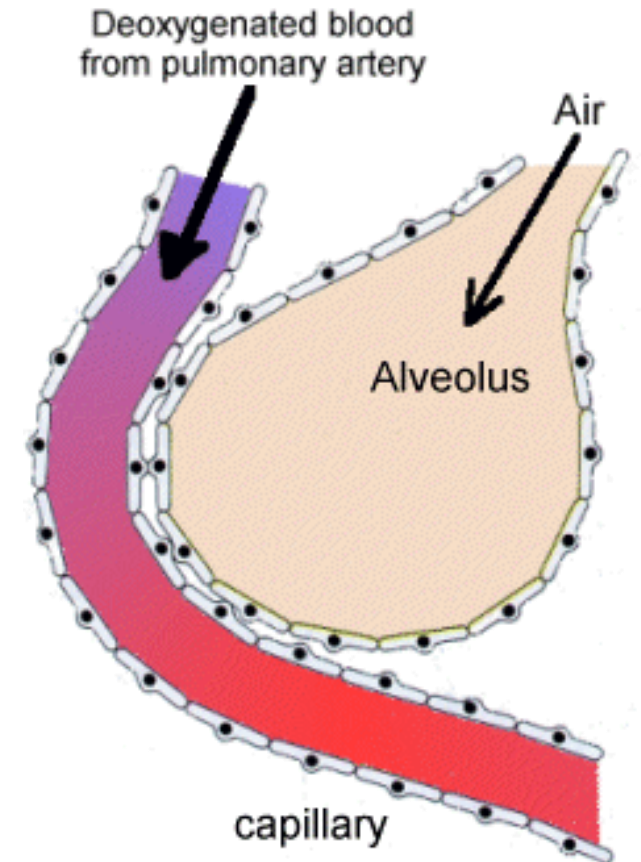


호흡의 과정

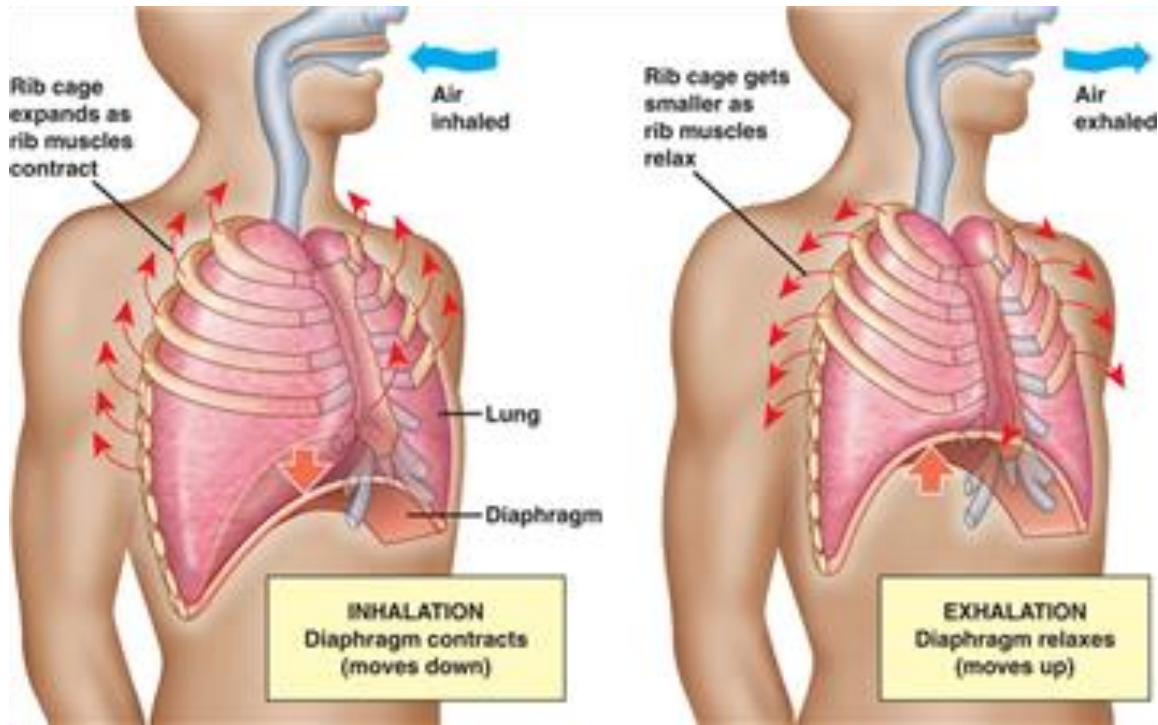


RESPIRATION (O₂ CONSUMPTION)

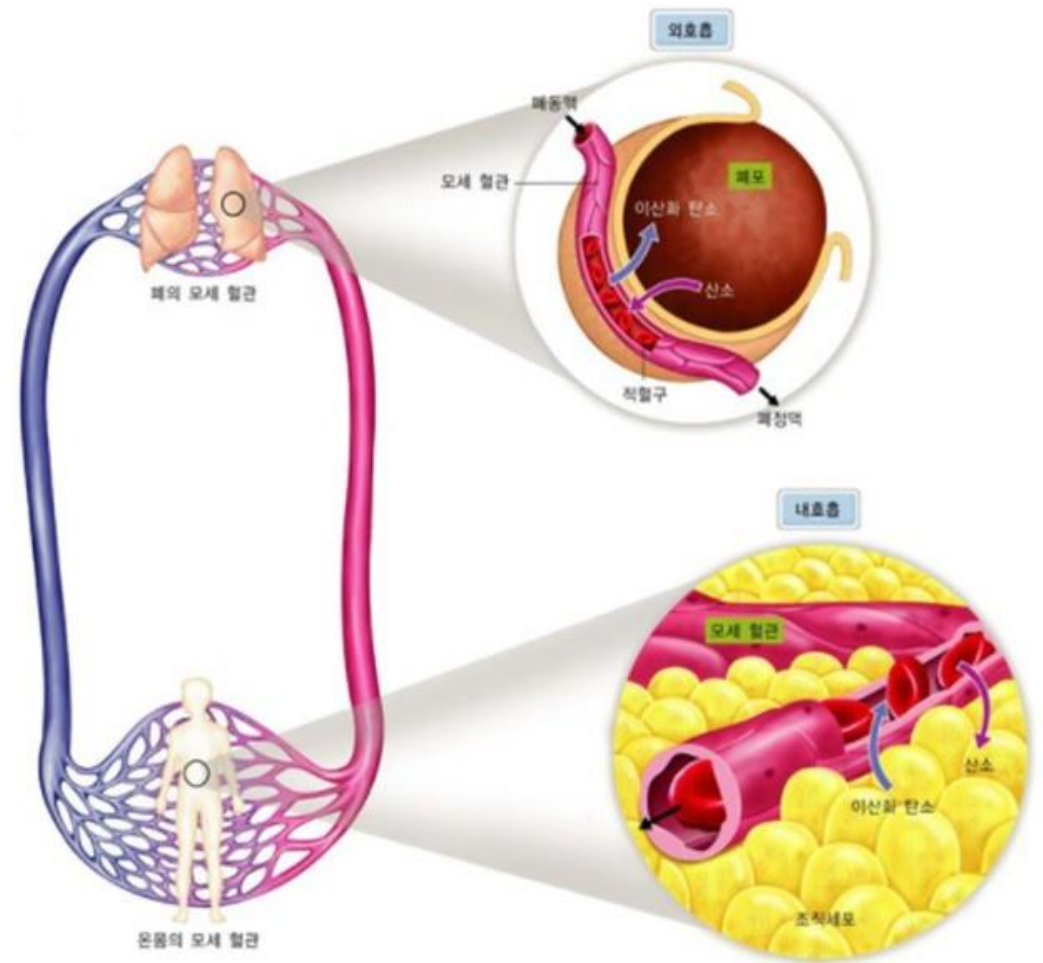
- Ventilation
 - From atmosphere to airway
- Gas exchange (diffusion)
 - From alveoli to pulmonary capillary
- Delivery (gas transportation)
 - From cardiopulmonary system to tissues
- Utilization (uptake)
 - At tissues



Ventilation (환기)



Diffusion (확산)





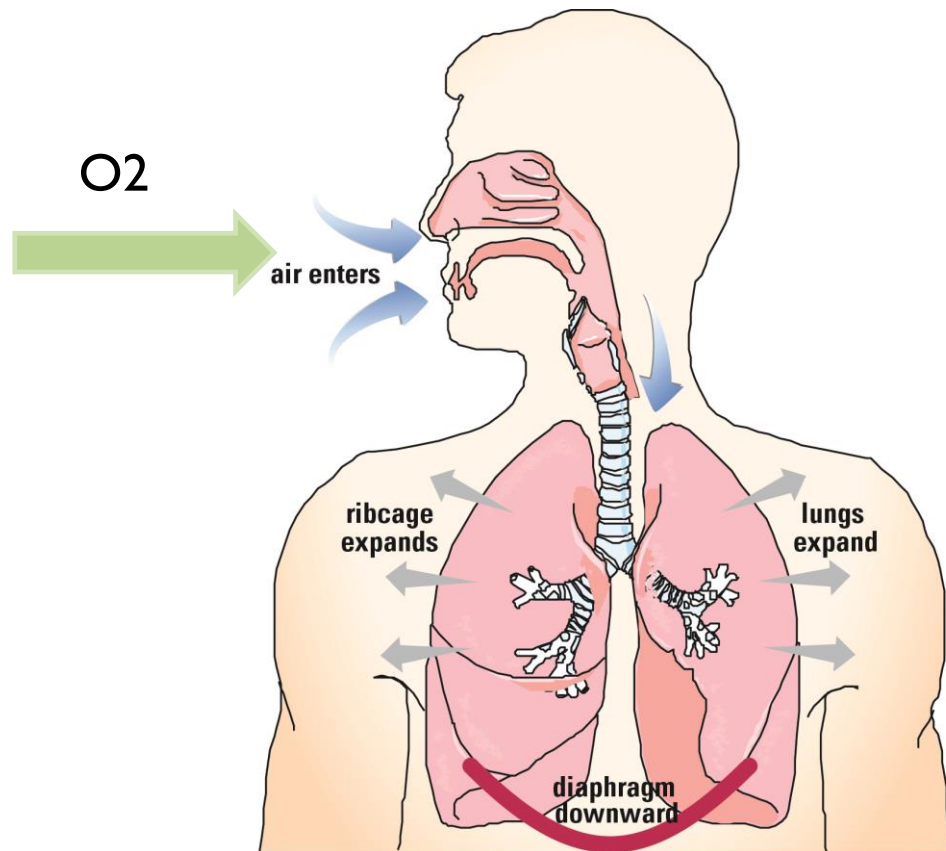
VENTILATION

FROM ATMOSPHERE TO AIRWAY

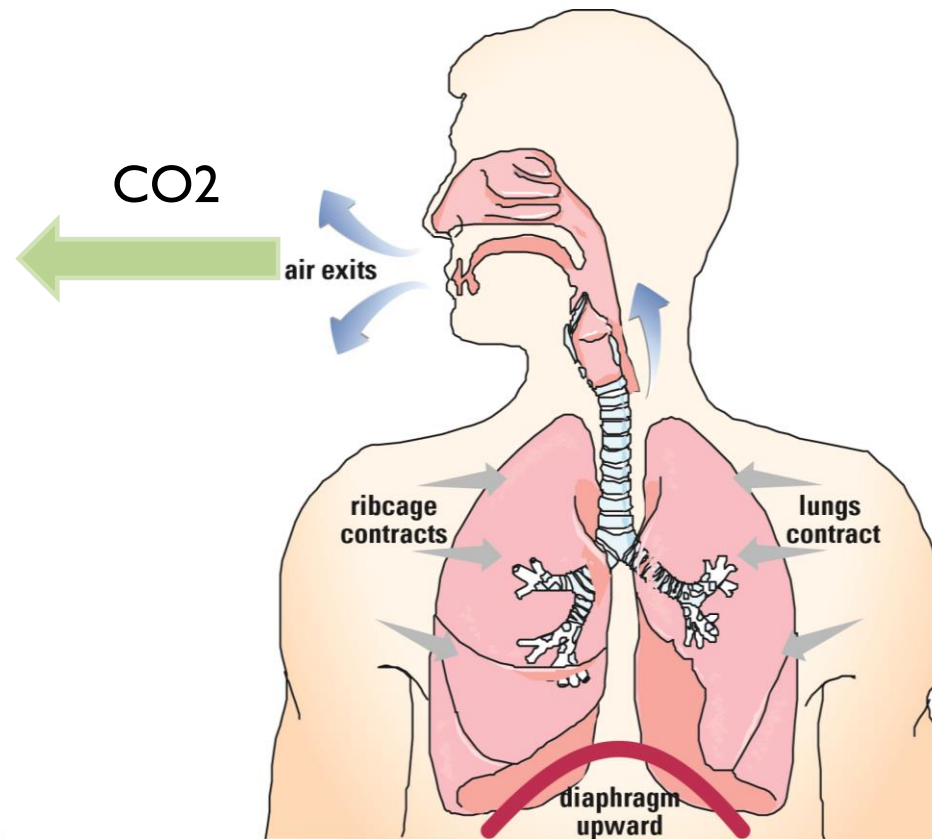


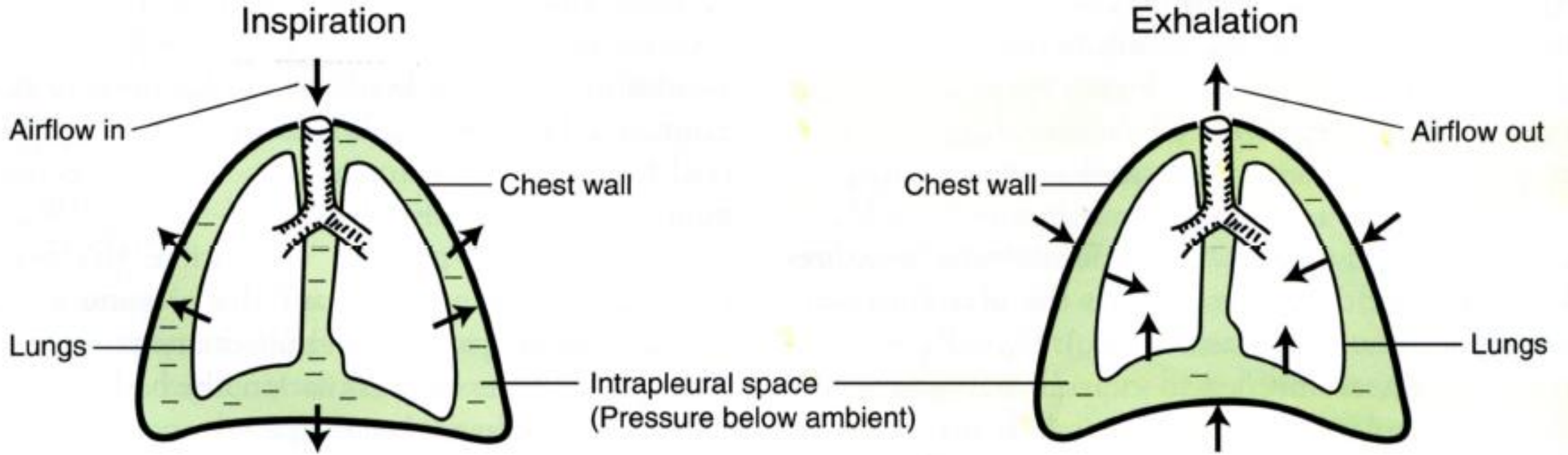
VENTILATION

Inhalation



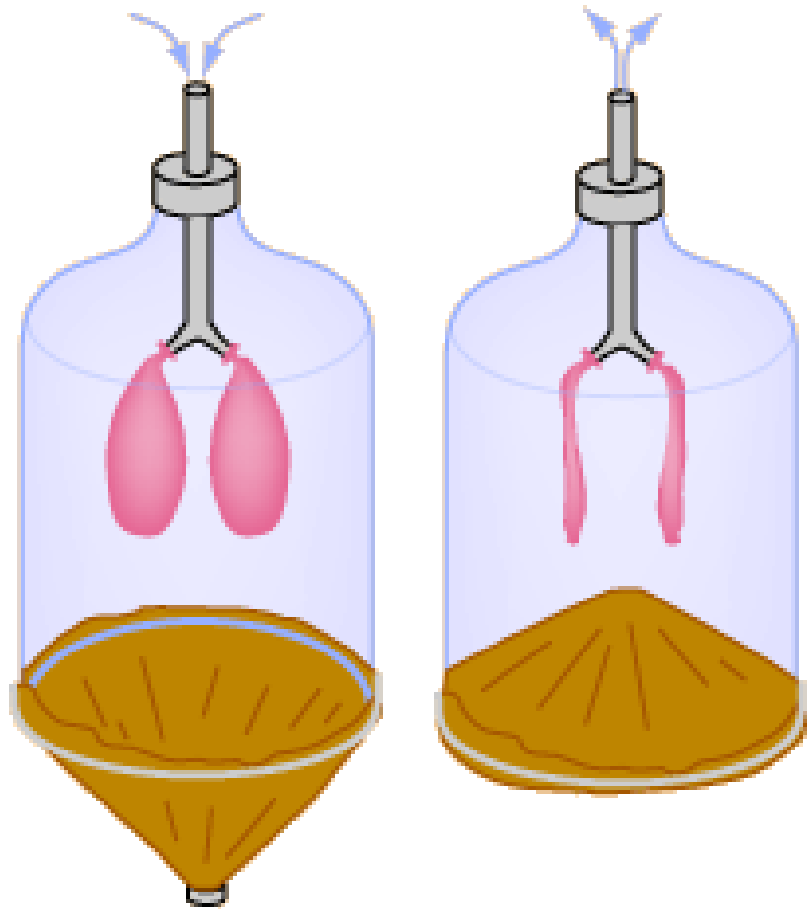
Exhalation





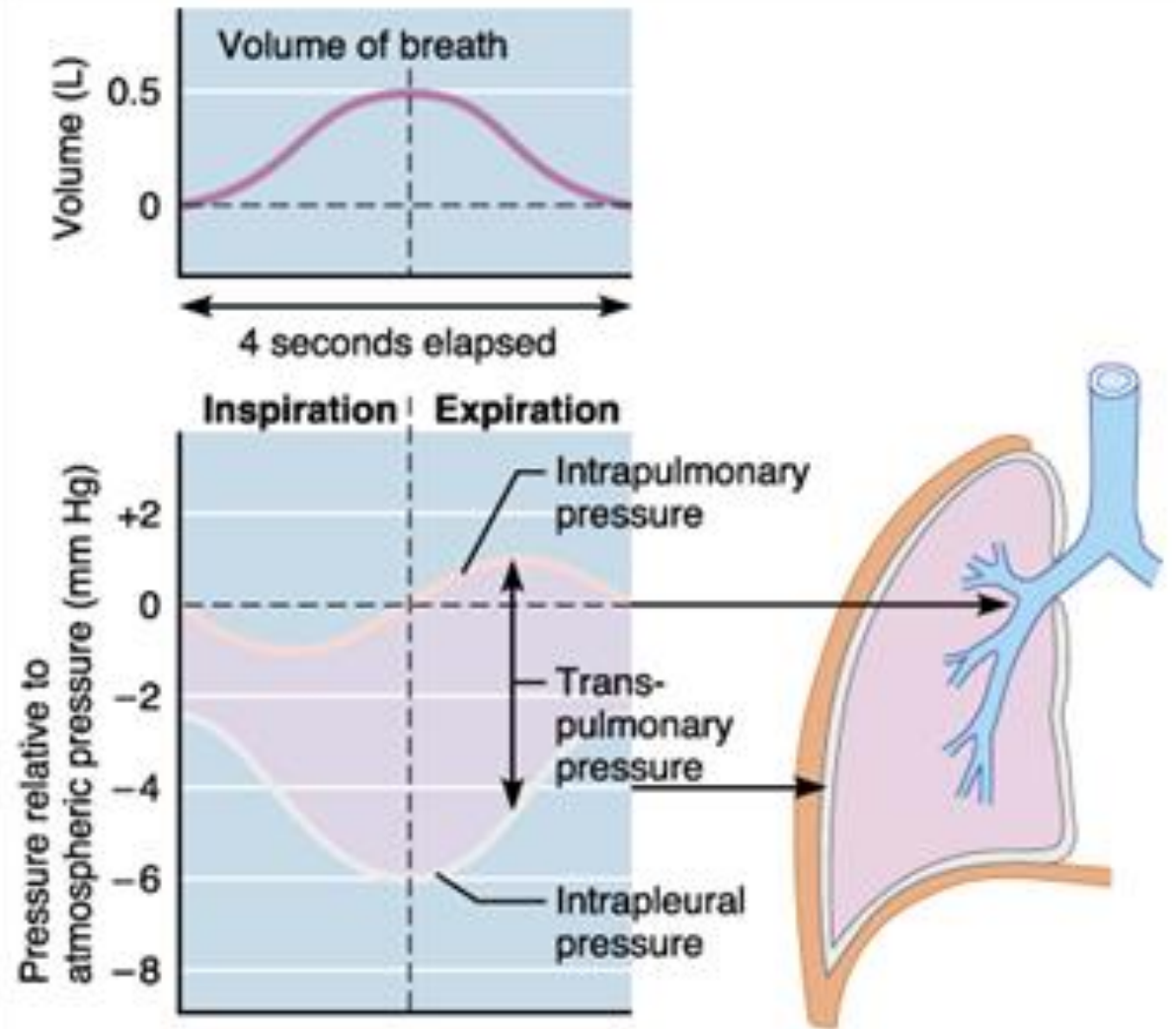
	횡격막	흉강의 압력	공기의 이동 방향
Inspiration	내려감	감소	
Expiration	올라감	증가	

Airflow ← pressure difference



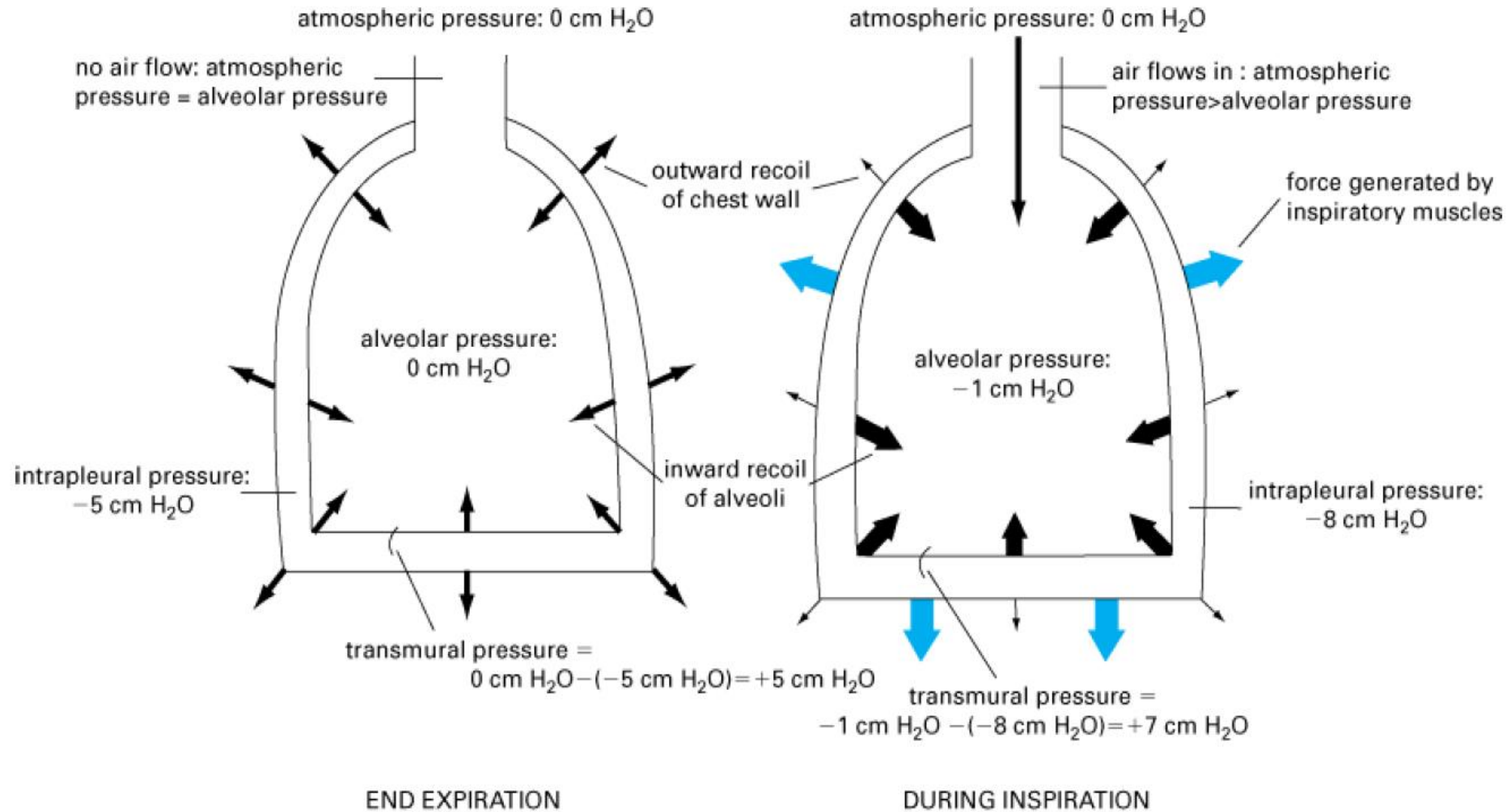
Inspiration

Expiration



Copyright © 2001 Benjamin Cummings, an imprint of Addison Wesley Longman, Inc.

Generation of pressure difference



* Alveolar pressure = intrapleural pressure + alveolar elastic recoil pressure

환기에 영향을 주는 요인

- 호흡수, 호흡 깊이
- 기도저항 (airway resistance)
- 순응도 (compliance)
- 탄성도 (elastic recoil) : 표면장력(surface tension), 폐조직 탄성

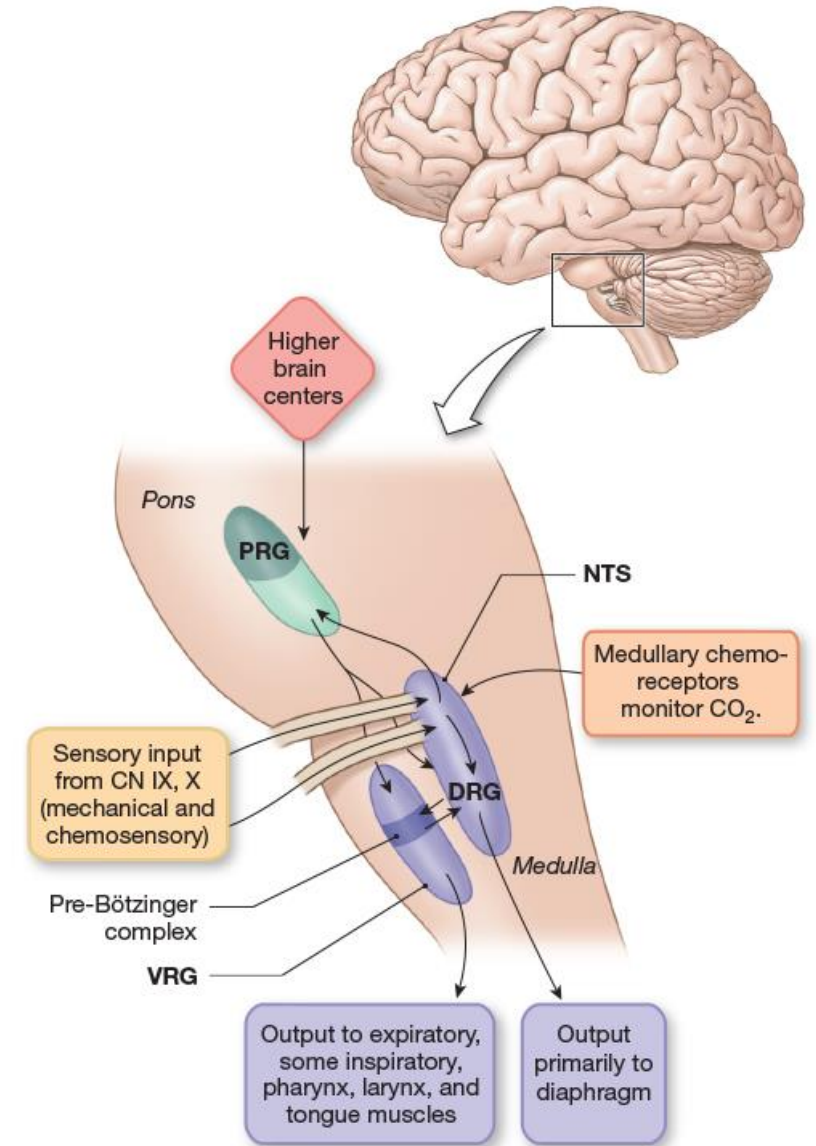
환기에 영향을 주는 요인

- 호흡수, 호흡 깊이
- 기도저항 (airway resistance)
- 순응도 (compliance)
- 탄성도 (elastic recoil) : 표면장력(surface tension), 폐조직 탄성

Mechanism of normal breathing



Chemoreceptors that monitor blood gas levels
CO₂ (primarily) and **O₂ (secondarily)**



KEY

PRG = Pontine respiratory group

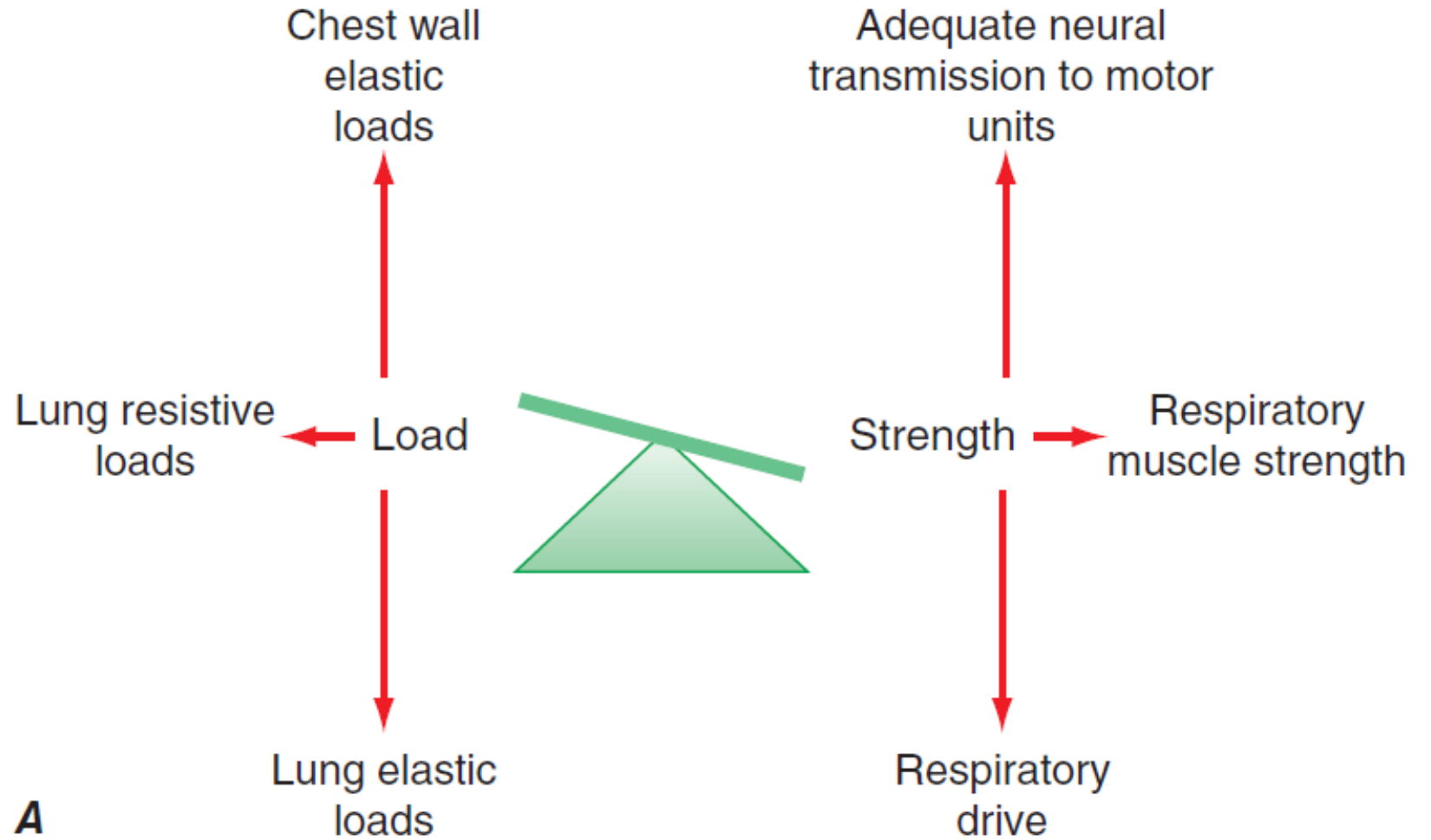
DRG = Dorsal respiratory group

VRG = Ventral respiratory group

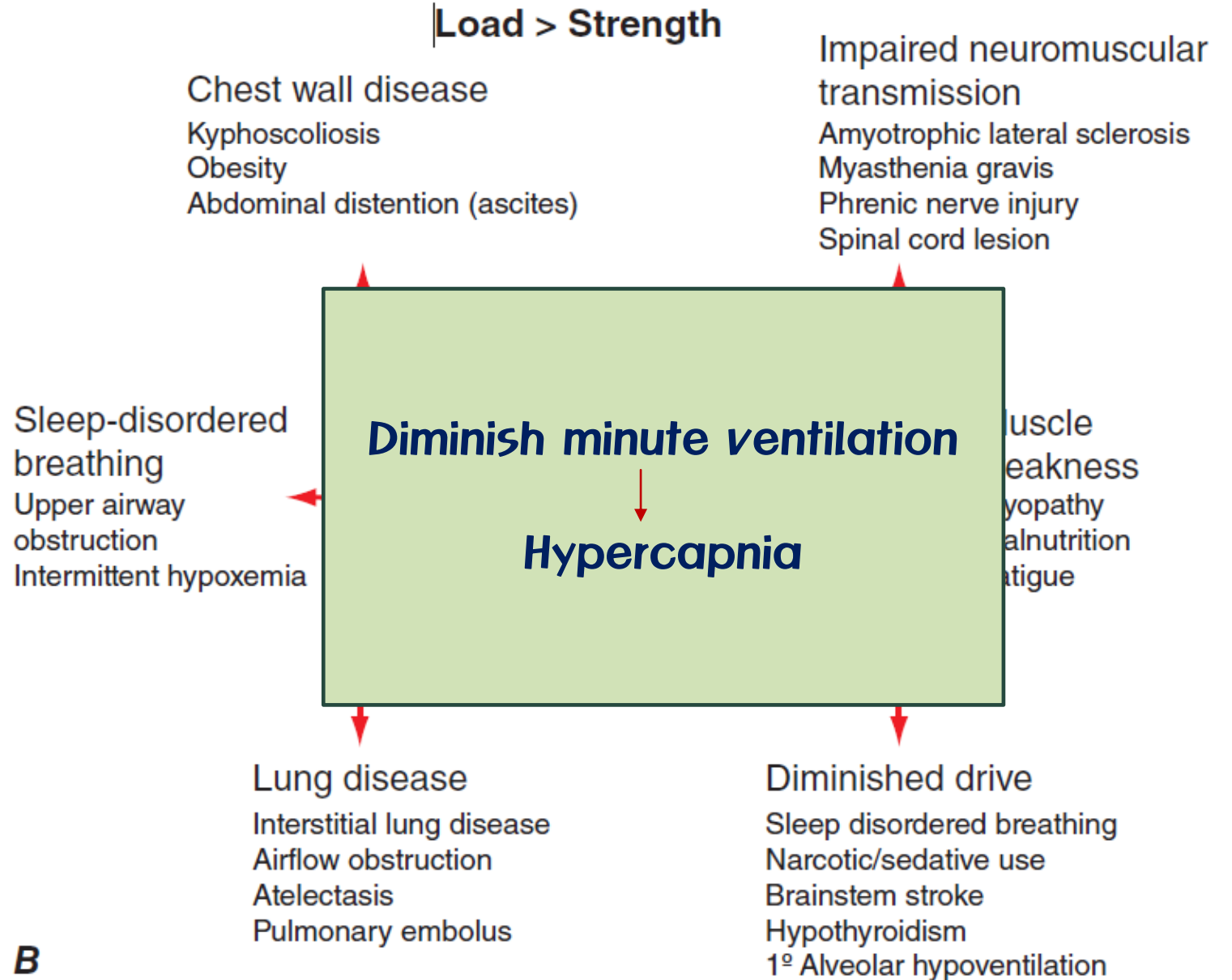
NTS = Nucleus tractus solitarius

In health

Excess respiratory muscle strength in health

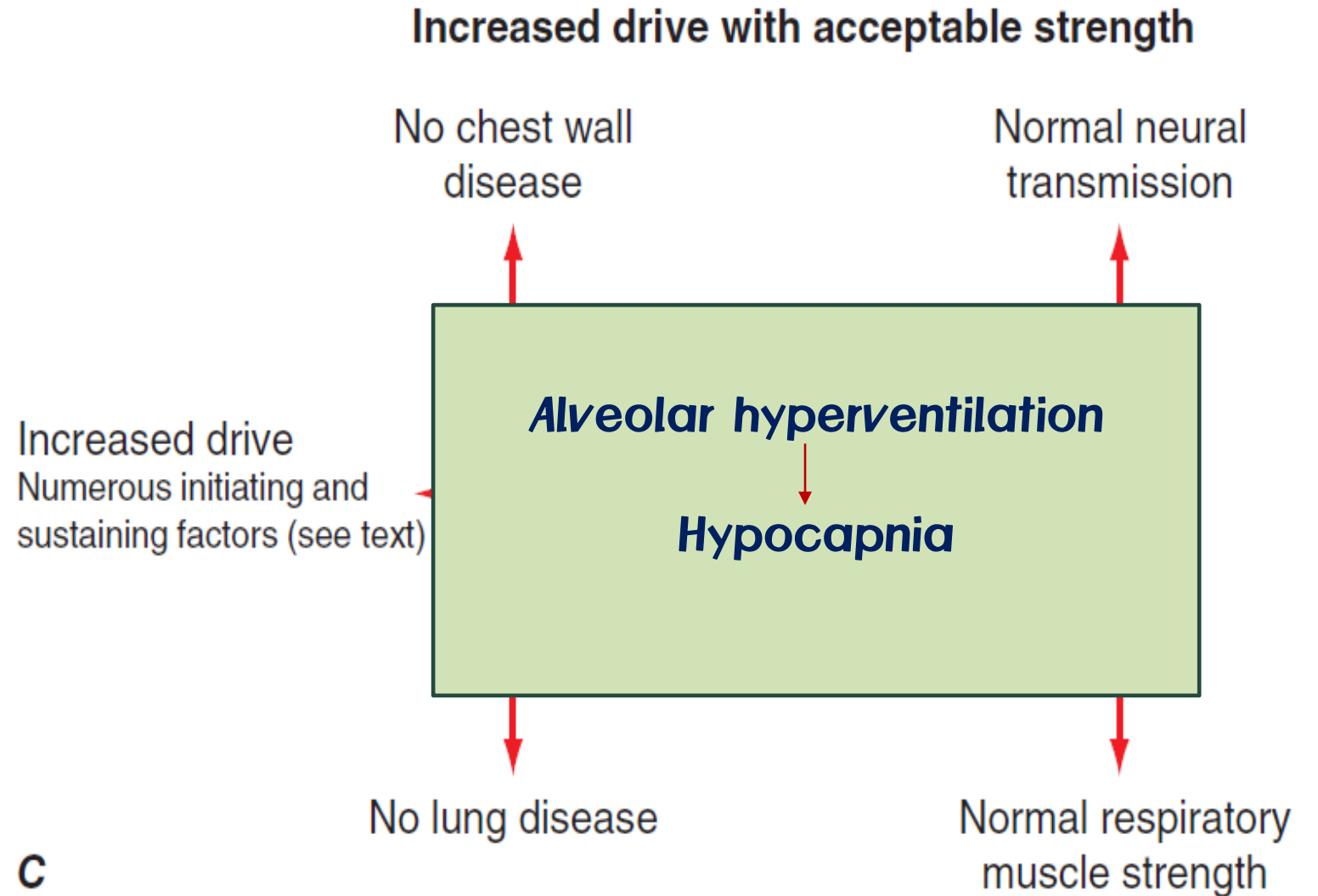


Hypoventilation



B

Hyperventilation



호흡기에 영향을 주는 요인

- 호흡수, 호흡 깊이
- 기도저항 (airway resistance)
- 순응도 (compliance)
- 탄성도 (elastic recoil) : 표면장력(surface tension), 폐조직 탄성

기도저항 (AIRWAY RESISTANCE)

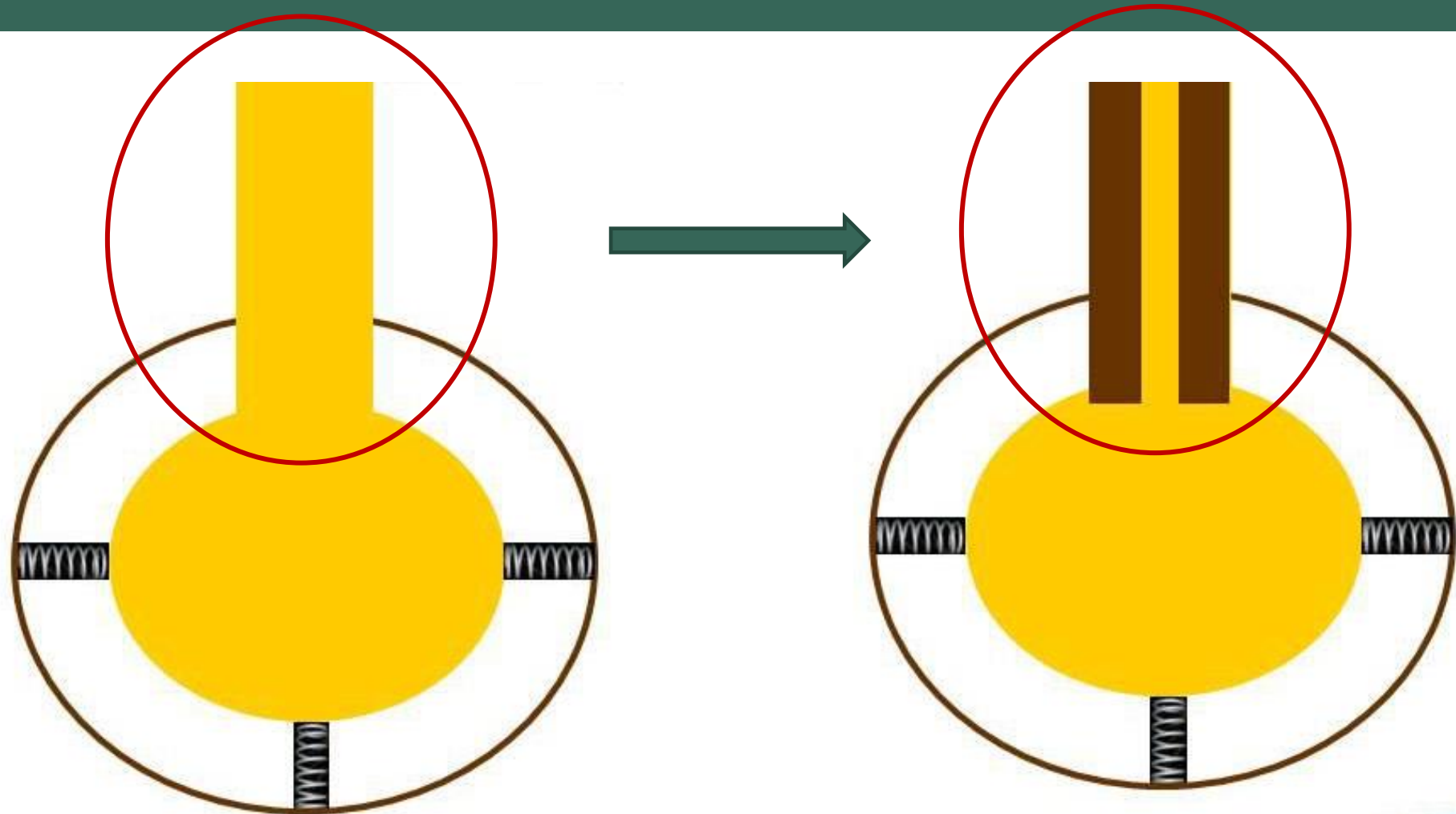
- 기도저항: the amount of pressure required to deliver a given flow of gas

$$R = \frac{\Delta P}{\text{Flow}}$$



Pressure Difference = Flow Rate x Resistance of the Tube

INCREASED AIRWAY RESISTANCE

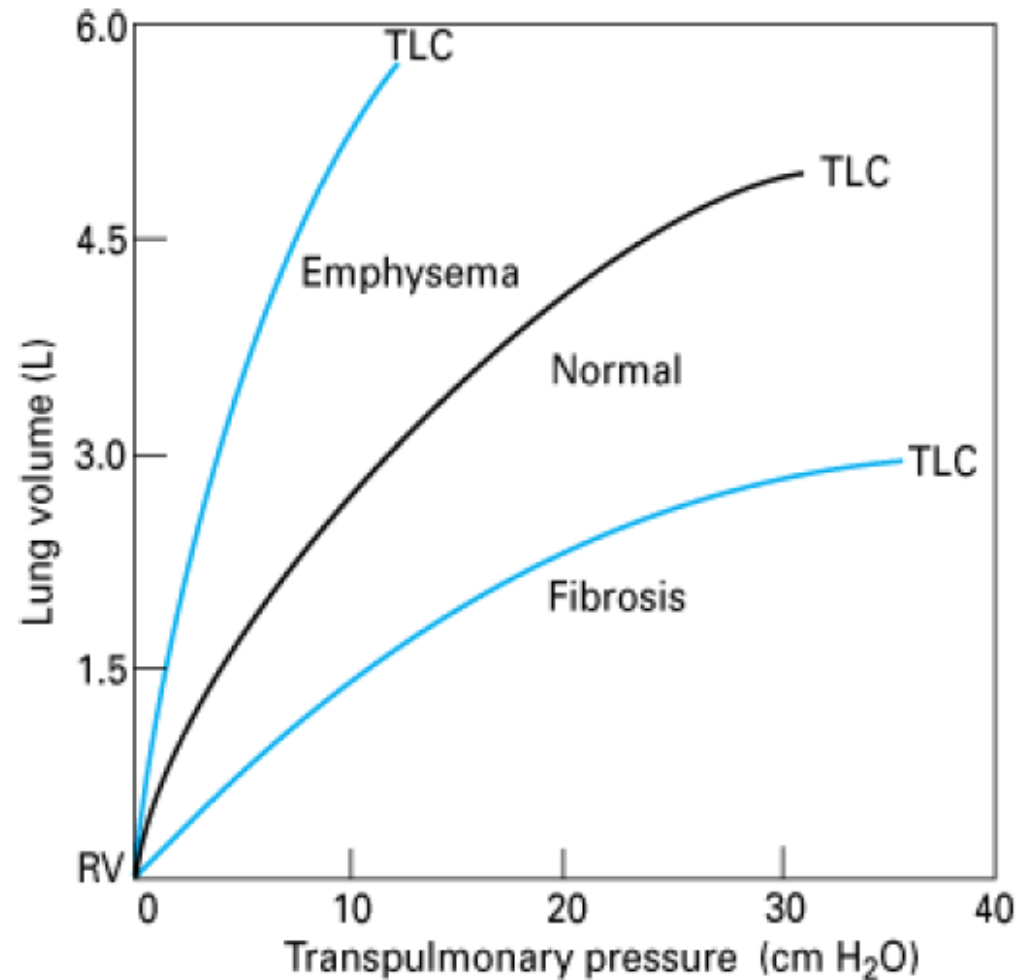


Diameter 감소	Diameter 증가
<ul style="list-style-type: none">• 기관지 분비물 증가• Bronchiole의 smooth muscle 수축<ul style="list-style-type: none">→ 기도 저항 증가, ventilation 감소→ 폐쇄성 폐질환 발생	<ul style="list-style-type: none">• Bronchiole의 smooth muscle 이완<ul style="list-style-type: none">→ 기도 저항 감소, ventilation 증가

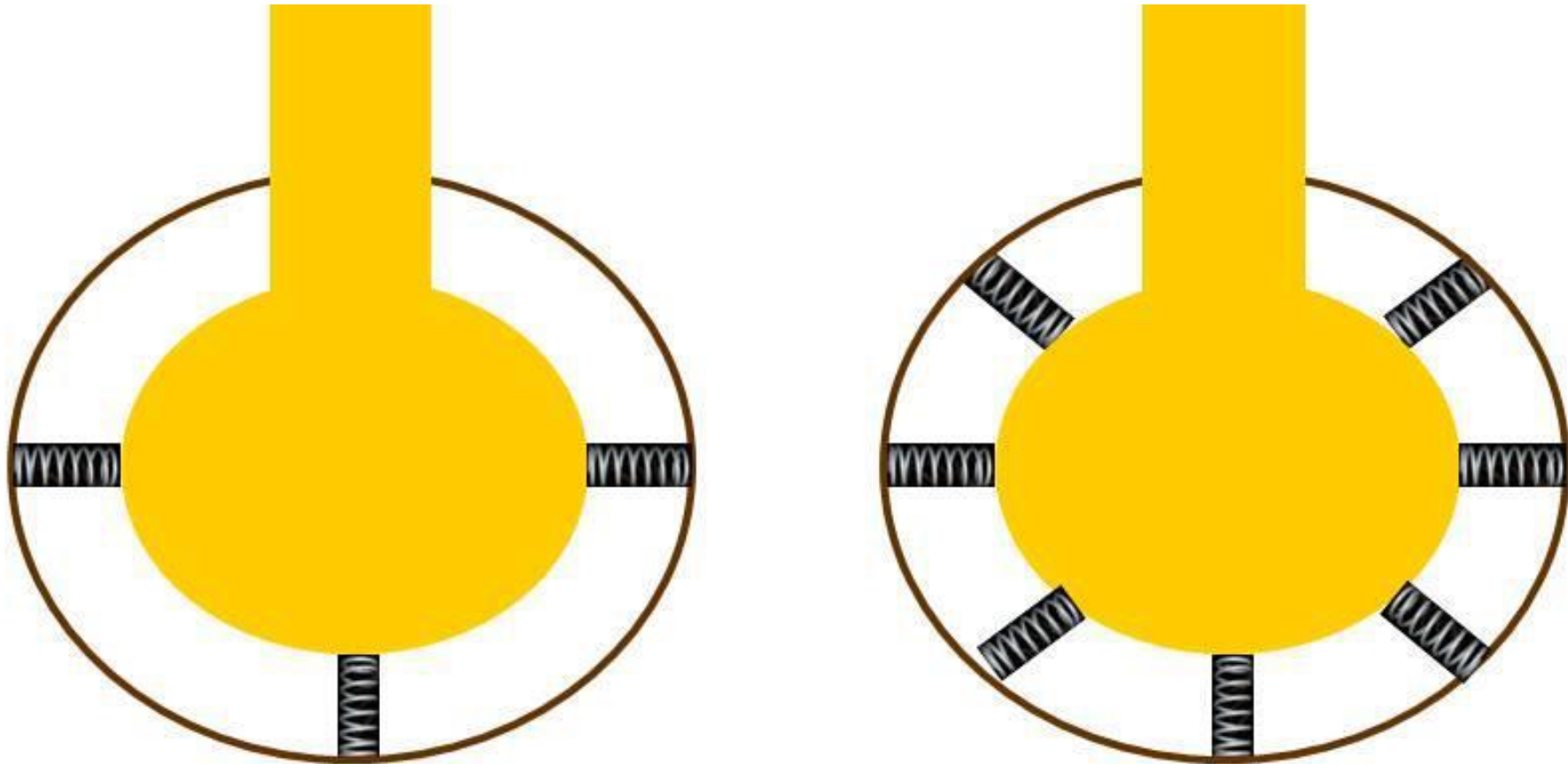
호흡기에 영향을 주는 요인

- 호흡수, 호흡 깊이
- 기도저항 (airway resistance)
- 순응도 (compliance)
- 탄성도 (elastic recoil) : 표면장력(surface tension), 폐조직 탄성

COMPLIANCE (순응도)

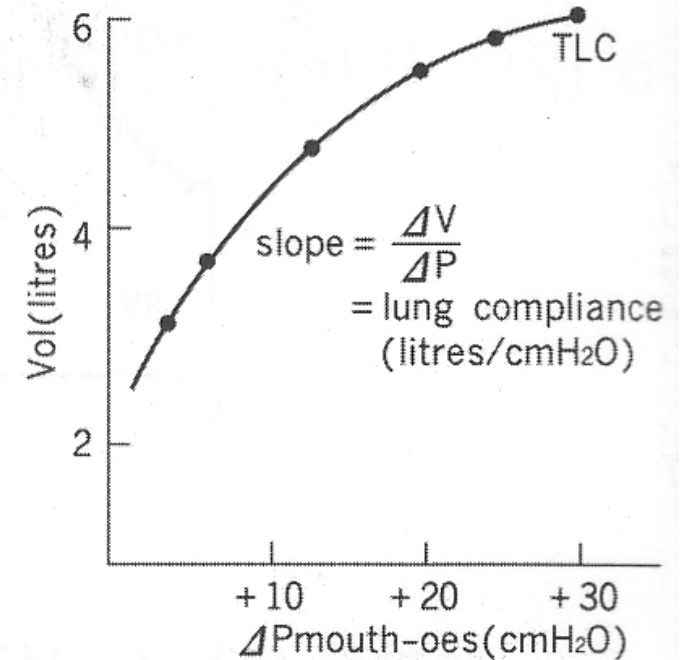
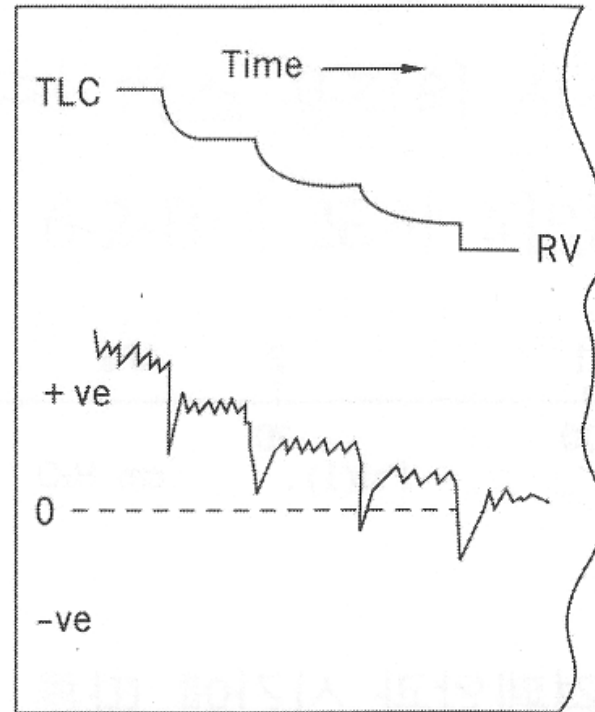
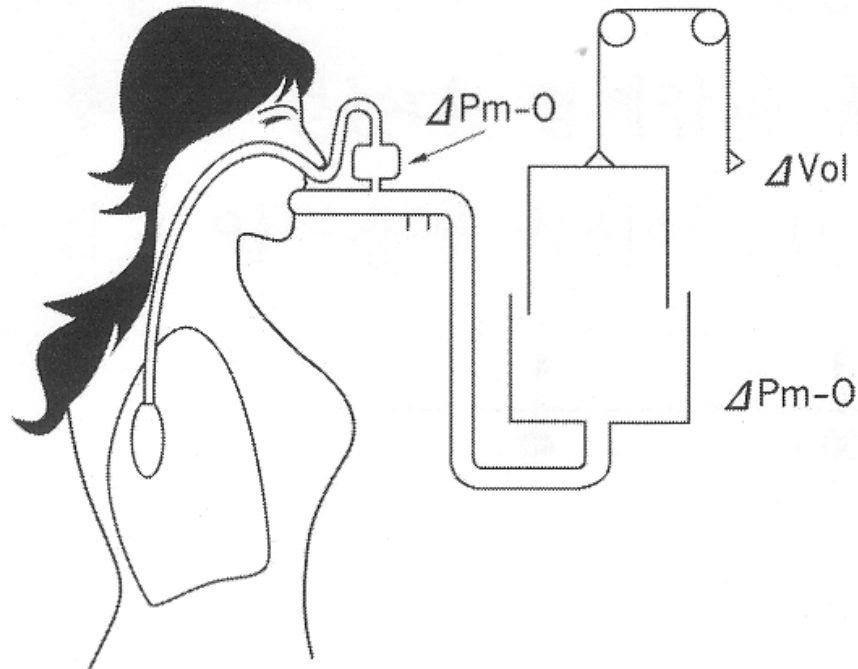


DECREASED LUNG COMPLIANCE



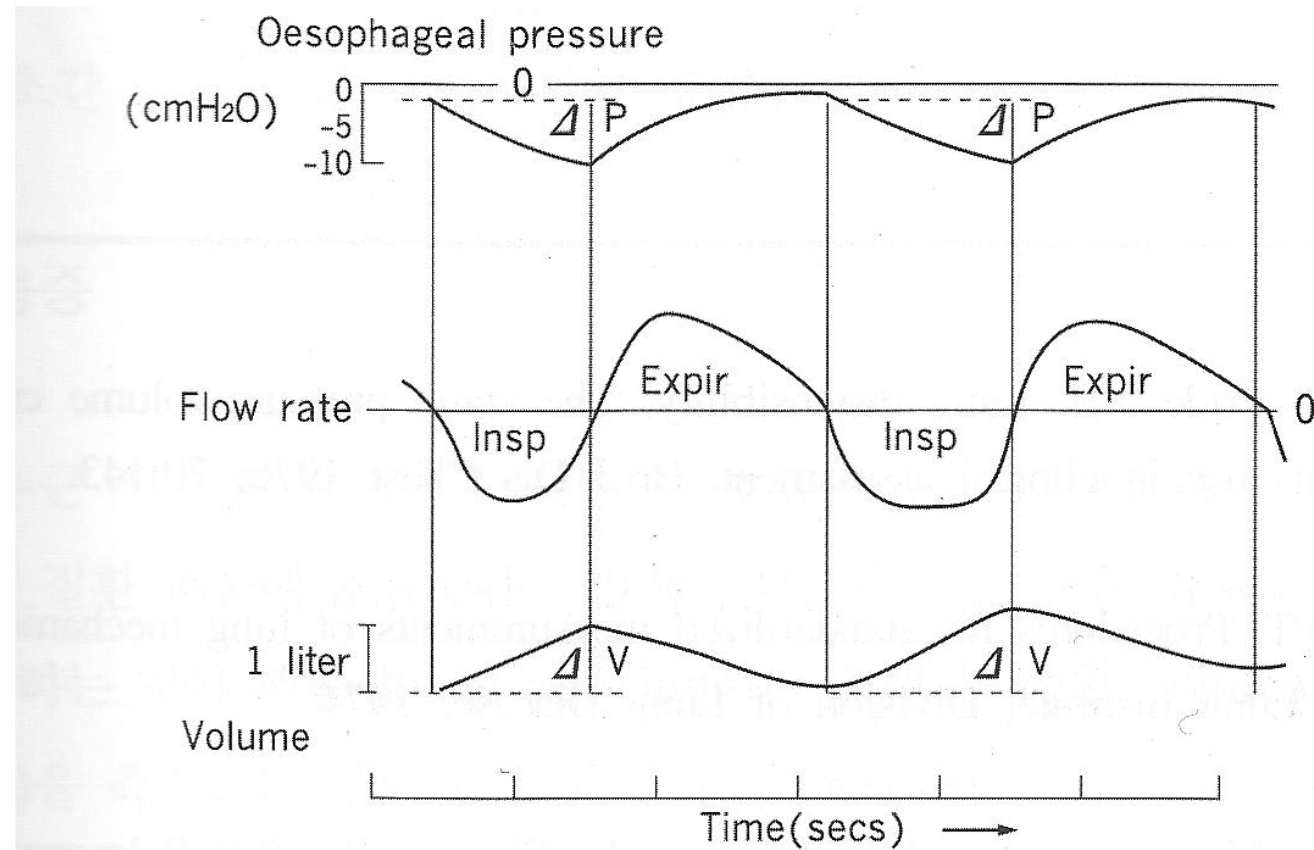
STATIC LUNG COMPLIANCE

- 공기의 이동이 없을 때의 유순도



DYNAMIC LUNG COMPLIANCE

- 공기의 이동이 일어날 때의 유순도

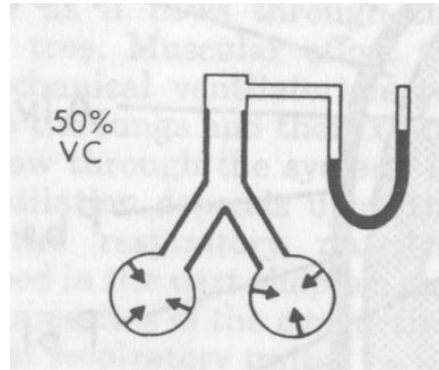


호흡기에 영향을 주는 요인

- 호흡수, 호흡 깊이
- 기도저항 (airway resistance)
- 순응도 (compliance)
- 탄성도 (elastic recoil) : 표면장력(surface tension), 폐조직 탄성

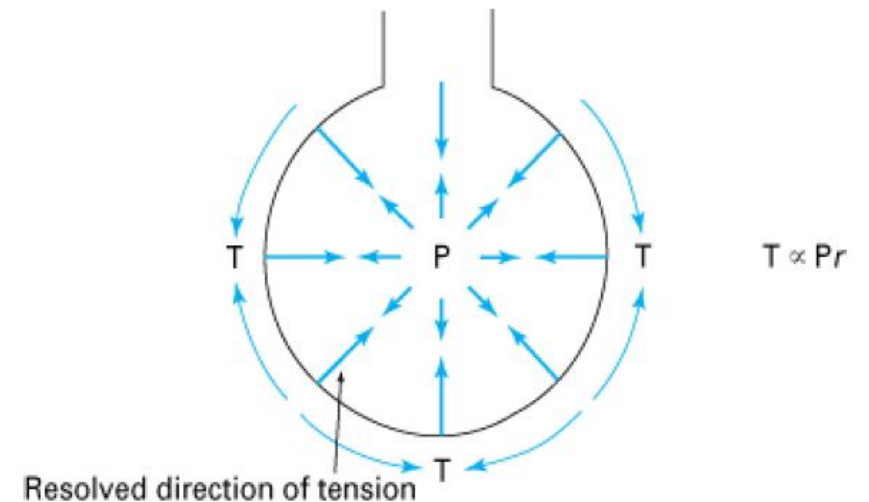
ELASTIC RECOIL = 1/COMPLIANCE

- Tissue elasticity of lung parenchyme



- Surface tension at gas-liquid interface

- 표면장력이 높을 수록, 폐포의 확장이 어려움
(compliance 감소)
- 계면활성제는 표면 장력을 감소시킴



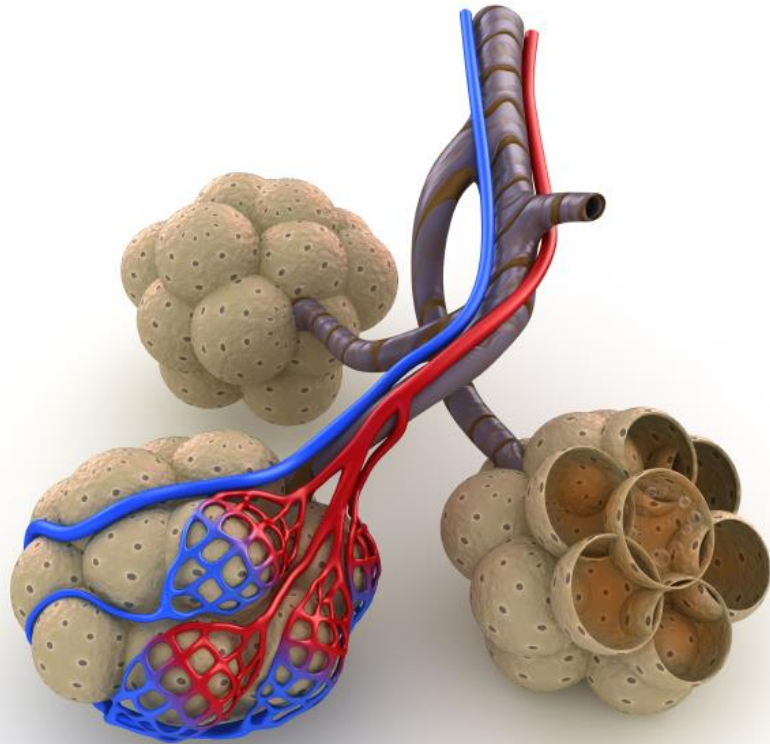


GAS EXCHANGE (DIFFUSION)

FROM ALVEOLI TO PULMONARY CAPILLARY



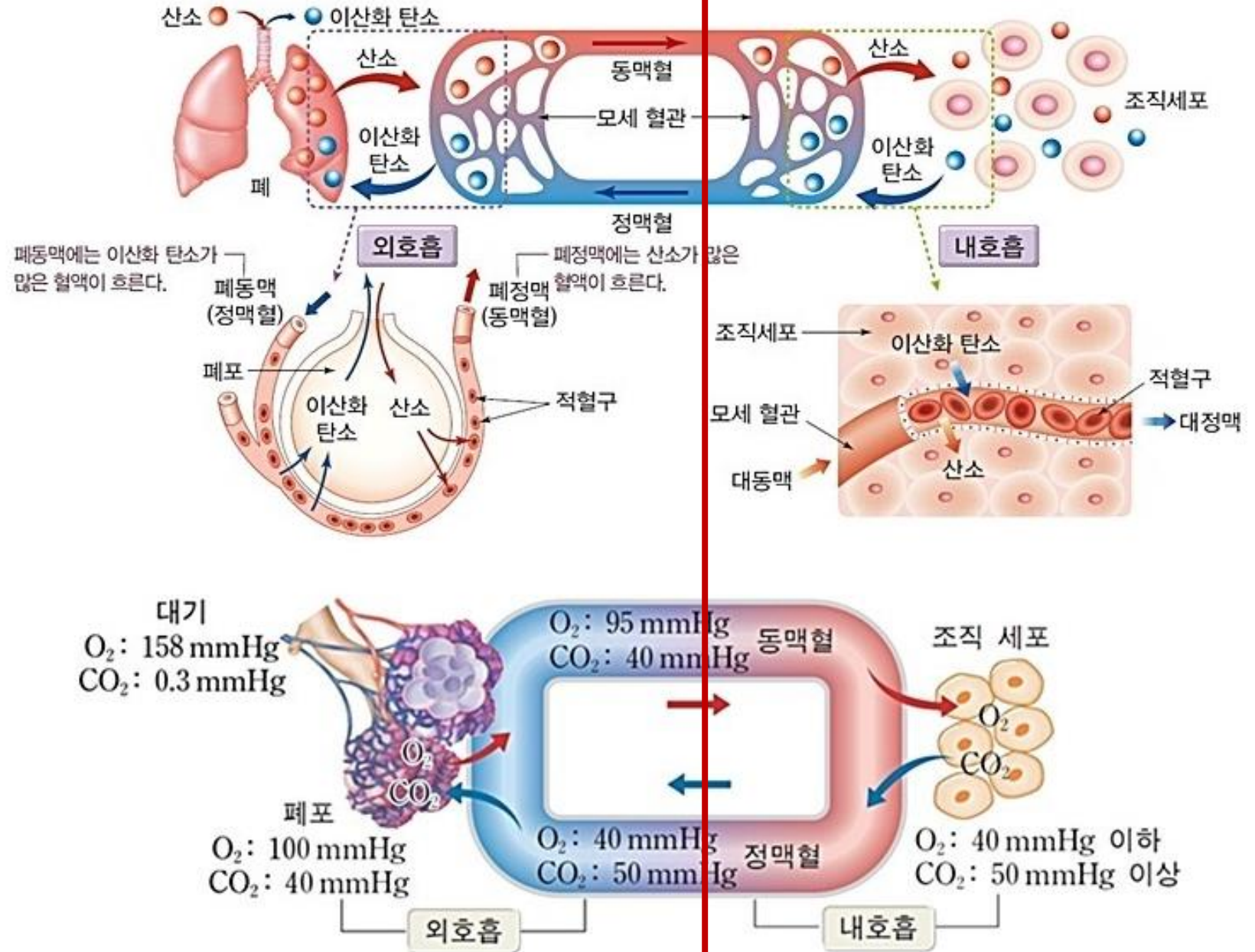
EXT. RESPIRATION – GAS EXCHANGE



Goals of respiration

- Bring oxygen to the body
- Remove carbon dioxide from the body

외호흡 & 내호흡 (Diffusion)





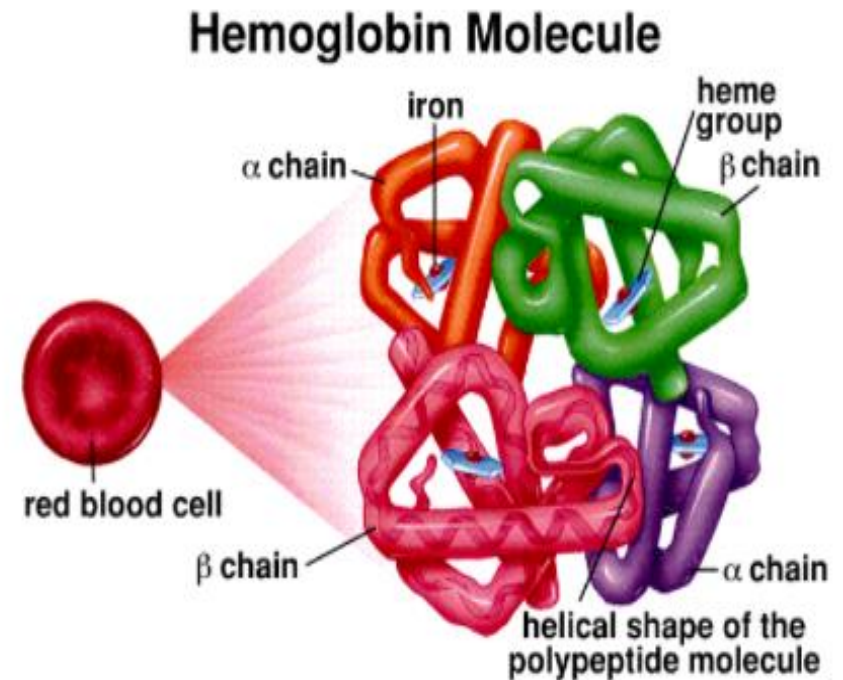
DELIVERY (GAS TRANSPORTATION)

FROM CARDIOPULMONARY SYSTEM TO TISSUES

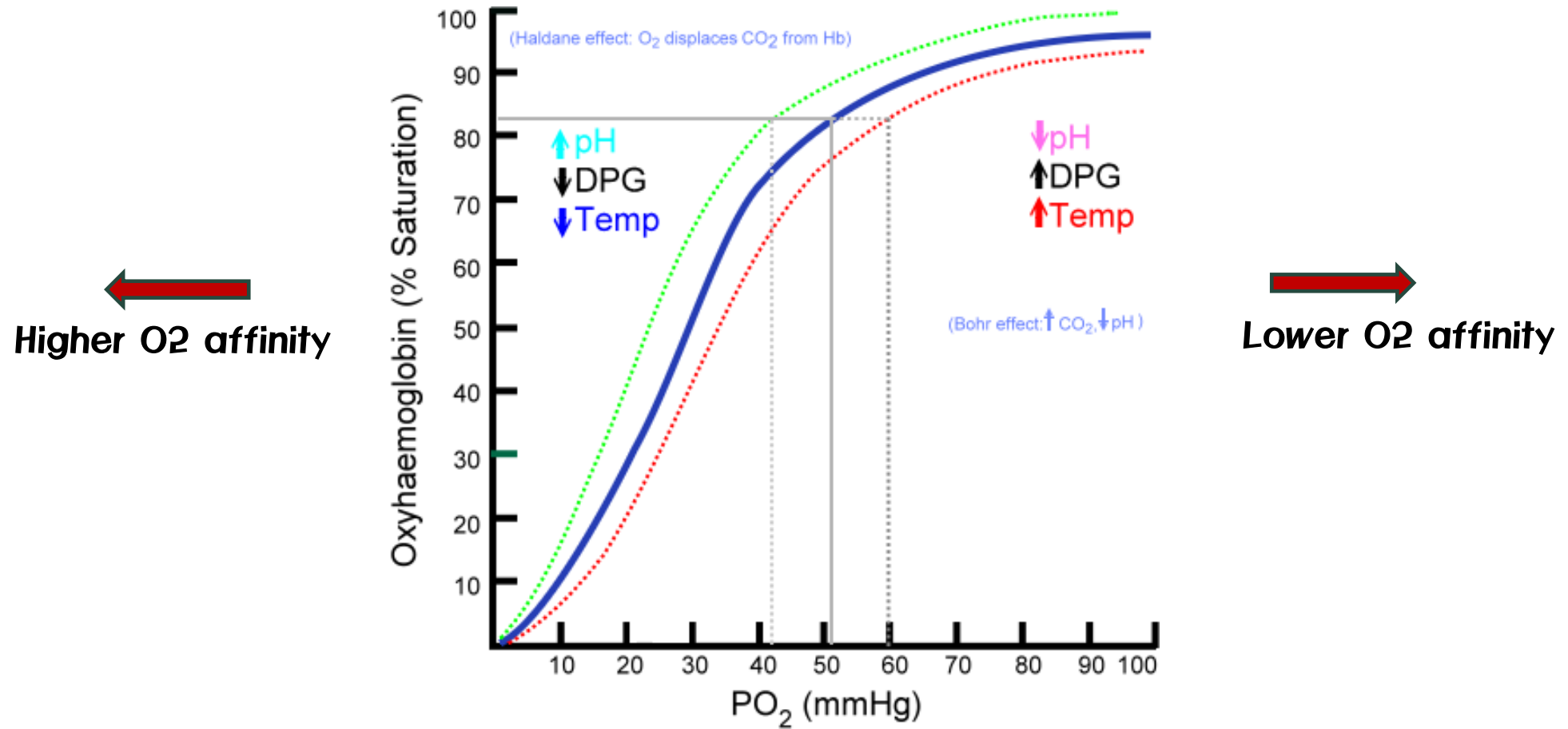


O₂ DELIVERY

- 물리적 용해 상태로 운반 – 일부 적은 양
- 대부분은 헤모글로빈 (Hb)과 결합한 형태로 운반됨
- 1개의 헤모글로빈은 4개의 산소와 결합
- 산소-헤모글로빈 해리 곡선에 영향을 주는 인자
 - 혈중 산소 분압
 - 온도
 - PCO₂, pH
 - 2,3 diphosphoglycerate



O₂-HEMOGLOBIN DISSOCIATION CURVE



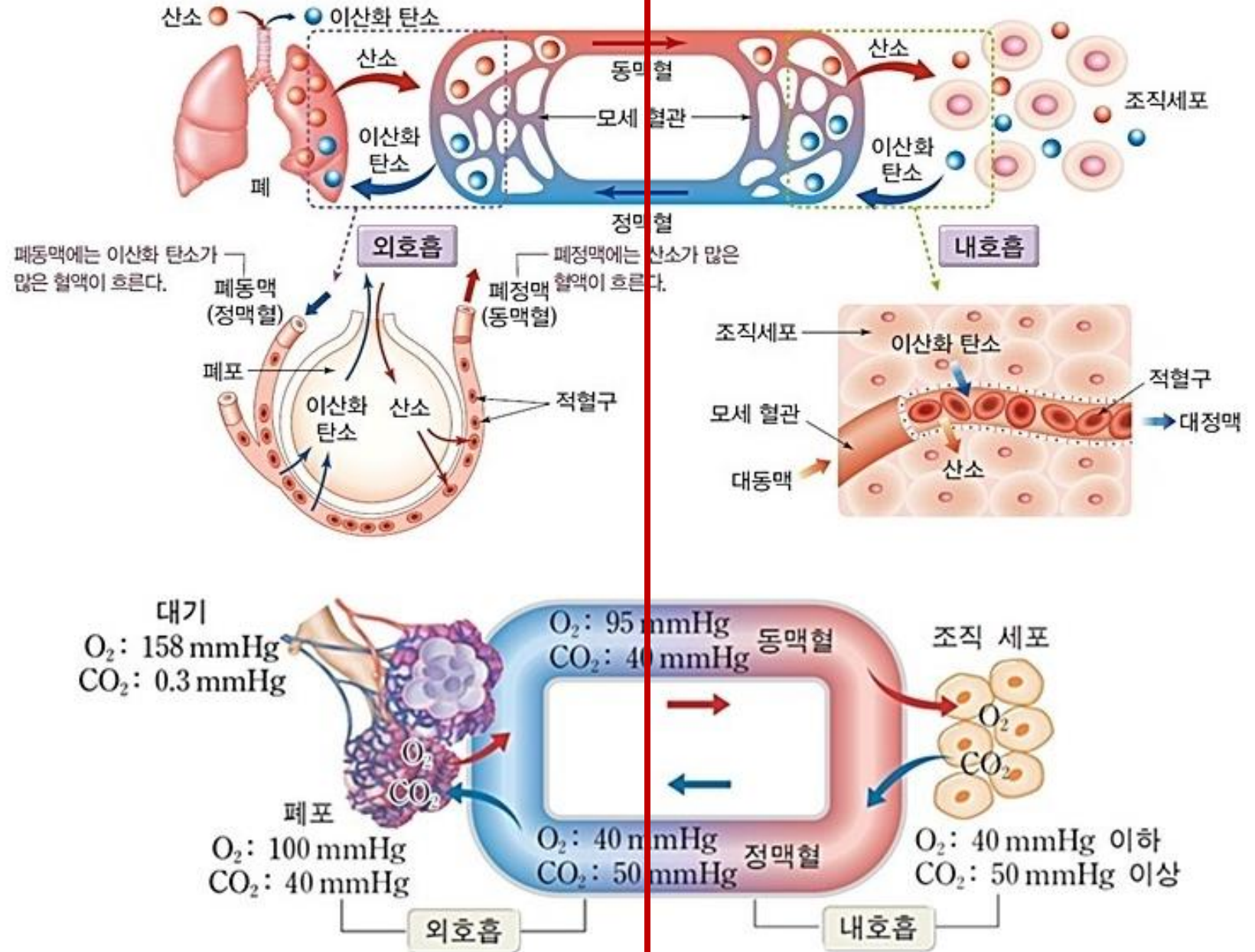


UTILIZATION (UPTAKE)

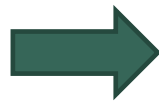
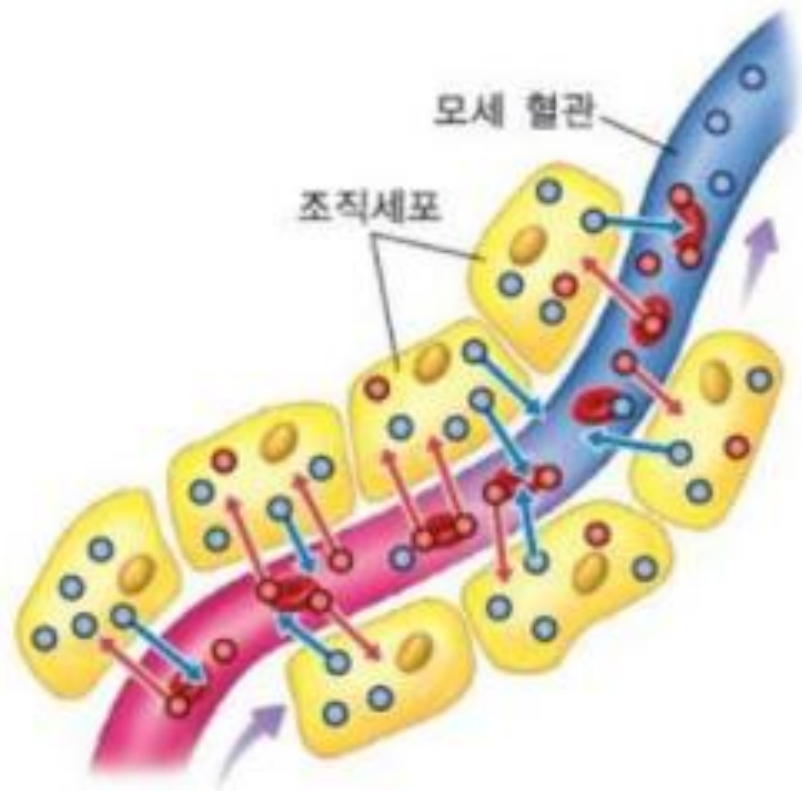
AT TISSUES



외호흡 & 내호흡 (Diffusion)



INT. RESPIRATION



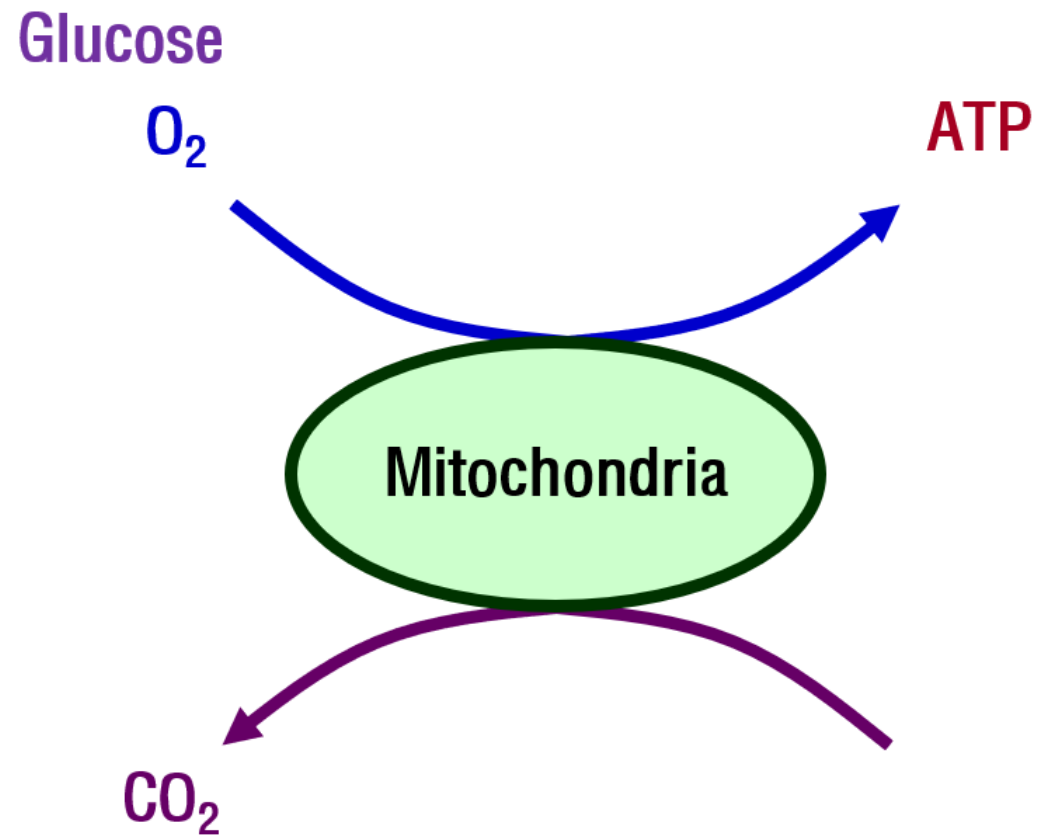
Glucose

O_2

ATP

Mitochondria

CO_2



SUMMARY

- 호흡기계 - 상부 호흡기 + 하부 호흡기
 - 전도영역 + 호흡영역
- 호흡의 과정
 - 폐포환기 (ventilation)
 - : pressure difference \Rightarrow airflow
 - : 호흡수, 기도저항, 순응도, 탄성도
 - 외호흡
 - 혈액을 통한 O_2 , CO_2 운반
 - 내호흡